3, 14, 16, 18, 19, 20, 24 to 31. Utah, 13, 15, 25. Vermont, 5, 17, 21. Virginia, 13, 14, 17, 20, 27, 28. Washington, 4, 11, 24, 25, 28, 29. West Virginia, 13, 14, 15, 17, 20, 21. Wisconsin, 2, 3, 16, 17, 20.

### HAIL.

The following are the dates on which hail fell in the respective States:

Arkansas, 2. California, 13, 14, 29, 30. Illinois, 17. Indiana, 17. Mississippi, 19. Missouri, 2. Texas, 30.

## WIND.

The *prevailing winds* for January, 1897, viz, those that were recorded most frequently, are shown in Table I for the regular Weather Bureau stations.

### HIGH WINDS.

*Maximum wind velocities* are given in Table I, which also gives the altitude of the Weather Bureau anemometers above the ground. Maxima of 50 miles or more per hour were reported during this month at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

| Stations. | Date. | Velocity. | Direction. | Stations. | Date. | Velocity. | Direction. |
|---|---|---|---|---|---|---|---|
| | | *Miles* | | | | *Miles* | |
| Amarillo, Tex | 2 | 54 | n. | Havre, Mont. | 21 | 50 | ne. |
| Block Island, R. I | 21 | 51 | se. | Huron, S. Dak | 3 | 50 | nw. |
| Do | 28 | 58 | nw. | Do | 4 | 51 | nw. |
| Buffalo, N. Y. | 17 | 59 | w. | Indianapolis, Ind | 17 | 57 | sw. |
| Do | 18 | 56 | w. | Nashville, Tenn | 3 | 53 | s. |
| Do | 22 | 53 | w. | New York, N. Y | 18 | 60 | nw. |
| Do | 23 | 55 | w | Do | 23 | 52 | nw. |
| Do | 25 | 58 | w. | Do | 26 | 52 | w. |
| Do | 26 | 55 | w. | Tatoosh Island, Wash. | 24 | 58 | e. |
| Chicago, Ill | 4 | 51 | w. | Do | 25 | 60 | e. |
| Do | 17 | 62 | w. | Toledo, Ohio | 17 | 50 | sw. |
| Cleveland, Ohio | 22 | 51 | w. | Williston, N. Dak | 21 | 58 | n. |
| Eastport, Me | 28 | 66 | e. | Woods Hole, Mass. | 21 | 50 | se. |
| Fort Canby, Wash. | 18 | 52 | se. | Do | 26 | 56 | w. |
| Do | 28 | 54 | e. | Do | 28 | 54 | ne. |

The *resultant winds*, as deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table VIII. These latter resultants are also shown graphically on Chart IV, where the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a uniform wind of average velocity. These figures indicate the relative extent to which winds from different directions counterbalanced each other.

## SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 22 regular stations of the Weather Bureau by its photographic, and at 35 by its thermal effects. At one of these stations records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table X for each hour of local mean time. In order to complete the record of the duration of cloudiness these registers are supplemented by special personal observations of the state of the sky near the sun in the hours after sunrise and before sunset, and the cloudiness for these hours has been added as a correction to the instrumental records, whence results a complete record of the duration of sunshine from sunrise to sunset.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table X.

*Difference between instrumental and personal observations of sunshine.*

| Stations. | Apparatus. | Total possible duration for the whole month. | Personal estimated area of clear sky. | Instrumental record of sunshine. | | | |
|---|---|---|---|---|---|---|---|
| | | | | Photographic. | Difference. | Thermometric. | Difference. |
| | | *Hrs.* | % | % | % | % | % |
| Tampa, Fla | T. | 328.7 | 53 | ..... | ..... | 55 | + 3 |
| Galveston, Tex | P. | 326.8 | 39 | 36 | − 3 | ..... | ..... |
| New Orleans, La | T. | 324.9 | 30 | ..... | ..... | 33 | + 2 |
| Savannah, Ga | P. | 320.5 | 48 | 43 | − 5 | ..... | ..... |
| Vicksburg, Miss | T. | 320.5 | 55 | ..... | ..... | 56 | + 1 |
| Charleston, S. C | T. | 318.5 | 51 | ..... | ..... | 54 | + 3 |
| Phœnix, Ariz. | P. | 318.5 | 57 | 63 | + 6 | ..... | ..... |
| San Diego, Cal | P. | 318.5 | 58 | 67 | + 9 | ..... | ..... |
| Atlanta, Ga | T. | 316.2 | 43 | ..... | ..... | 44 | + 1 |
| Los Angeles, Cal | P. | 316.2 | 58 | 66 | + 8 | ..... | ..... |
| Wilmington, N. C | T. | 316.2 | 56 | ..... | ..... | 60 | + 4 |
| Chattanooga, Tenn | T. | 314.6 | 41 | ..... | ..... | 42 | + 1 |
| Little Rock, Ark | T. | 314.6 | 41 | ..... | ..... | 53 | +12 |
| Nashville, Tenn | P. | 311.8 | 49 | ..... | ..... | 55 | + 6 |
| Raleigh, N. C | T. | 311.8 | 47 | ..... | ..... | 55 | + 8 |
| Santa Fe, N. Mex | P. | 311.8 | 56 | 65 | + 9 | ..... | ..... |
| Fresno, Cal | T. | 309.0 | 22 | ..... | ..... | 19 | − 3 |
| Dodge City, Kans | P. | 306.5 | 61 | 68 | + 7 | ..... | ..... |
| Louisville, Ky | T. | 306.5 | 37 | ..... | ..... | 45 | + 8 |
| San Francisco, Cal | T. | 306.5 | 40 | ..... | ..... | 53 | +13 |
| Atlantic City, N. J | P. | 303.8 | 48 | 54 | + 6 | ..... | ..... |
| Baltimore, Md | T. | 303.8 | 45 | ..... | ..... | 38 | − 7 |
| Cincinnati, Ohio | T. | 303.8 | 37 | ..... | ..... | 38 | + 1 |
| Kansas City, Mo | P. | 303.8 | 49 | 53 | + 4 | ..... | ..... |
| St. Louis, Mo | T. | 303.8 | 43 | ..... | ..... | 56 | +13 |
| Washington, D. C | P. | 303.8 | 50 | 54 | + 4 | ..... | ..... |
| Columbus, Ohio | T. | ..... | ..... | ..... | ..... | ..... | ..... |
| Denver, Colo | P. | 301.1 | 54 | 65 | +11 | ..... | ..... |
| Indianapolis, Ind | T. | 301.1 | 37 | ..... | ..... | 56 | +19 |
| Philadelphia, Pa | T. | 301.1 | 44 | ..... | ..... | 54 | +10 |
| Cheyenne, Wyo | P. | 298.4 | 46 | 62 | +16 | ..... | ..... |
| Eureka, Cal | P. | 298.4 | 34 | 33 | − 1 | ..... | ..... |
| New York, N. Y | T. | 298.4 | 45 | ..... | ..... | 54 | + 9 |
| Omaha, Nebr | P. | 298.4 | 48 | 53 | + 4 | ..... | ..... |
| Pittsburg, Pa | T. | 298.4 | 26 | ..... | ..... | 20 | − 6 |
| Salt Lake City, Utah | P. | 298.4 | 25 | 44 | +19 | ..... | ..... |
| Binghamton, N. Y | T. | 295.5 | 25 | ..... | ..... | 26 | + 1 |
| Boston, Mass | T. | 295.5 | 39 | ..... | ..... | 46 | + 7 |
| Chicago, Ill | T. | 295.5 | 37 | ..... | ..... | 38 | + 1 |
| Cleveland, Ohio | T. | 295.5 | 18 | ..... | ..... | 19 | + 1 |
| Des Moines, Iowa | T. | 295.5 | 53 | ..... | ..... | 54 | + 1 |
| Detroit, Mich | T. | 295.5 | 27 | ..... | ..... | 34 | + 7 |
| Dubuque, Iowa | T. | 295.5 | 39 | ..... | ..... | 35 | − 4 |
| Albany, N. Y. * | T. | 292.7 | 30 | ..... | ..... | 37 | + 7 |
| Buffalo, N. Y | T. | 292.7 | 21 | ..... | ..... | 23 | + 2 |
| Rochester, N. Y | T. | 292.7 | 24 | ..... | ..... | 30 | + 6 |
| Northfield, Vt | P. | 290.7 | 33 | 30 | + 6 | ..... | ..... |
| Portland, Me | T. | 289.7 | 49 | ..... | ..... | 56 | + 7 |
| Eastport, Me | P. | 286.7 | 35 | 50 | +15 | ..... | ..... |
| Minneapolis, Minn † | T. | 286.7 | ..... | ..... | ..... | 39 | ..... |
| St. Paul, Minn. | P. | 286.7 | 38 | 38 | 0 | ..... | ..... |
| Portland, Oreg | T. | 283.1 | 29 | ..... | ..... | 24 | − 5 |
| | P. | 283.1 | 29 | 22 | − 7 | ..... | ..... |
| Bismarck, N. Dak | P. | 279.9 | 35 | 42 | + 7 | ..... | ..... |
| Helena, Mont | P. | 279.9 | 41 | 41 | 0 | ..... | ..... |
| Seattle, Wash | T. | 276.2 | 25 | ..... | ..... | 20 | − 5 |
| Spokane, Wash | P. | 276.2 | 20 | 9 | −11 | ..... | ..... |

* Instrumental record is for 23 days, for which the total possible is 214.5.
† No personal record is kept at Minneapolis.

### COMPARISON OF DURATIONS AND AREAS.

The sunshine registers give the *durations* of effective sunshine whence the duration relative to possible sunshine is derived; the observers' personal estimates give the percentage of *area* of clear sky. These numbers have no necessary relation to each other, since stationary banks of clouds may obscure the sun without covering the sky, but when all clouds have a steady motion past the sun and are uniformly scattered over the sky, the percentages of duration and of area agree closely. For the sake of comparison, these percentages have been brought together, side by side, in the following table, from which it appears that, in general, the instrumental records of percentages of durations of sunshine are almost always larger than the observers' personal estimates of percentages of area of clear sky; the average excess for January, 1897, is 5 per

cent for photographic and 4 per cent for thermometric records.

The details are shown in the preceding table, in which the stations are arranged according to the *total possible* duration of sunshine, and not according to the *observed* duration as in previous years.

### ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IX, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

*Thunderstorms.*—The dates on which reports of thunderstorms for the whole country were most numerous were: 1st, 40; 2d, 64; 16th, 73.

Thunderstorm reports were most numerous in: Louisiana, 27; Missouri, 42; Ohio, 50.

Thunderstorms were most frequent in: Louisiana, 9 days; Arizona and Ohio, 7; Missouri and Texas, 6.

*Auroras.*—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from the 14th to the 22d, inclusive. On the remaining twenty-two days of this month 104 reports were received, or an average of about 5 per day. The dates on which the number of reports especially exceeded this average were: 1st, 15; 2d, 52.

Auroras were reported most frequently in: Montana and South Dakota, 7 days; North Dakota, 6.

The number of reports was a large percentage of the number of observers in: Vermont, 62; Maine, 56; South Dakota, 37; Montana, 30; North Dakota, 25.

### CANADIAN REPORTS.

A thunderstorm was reported at Montreal on the 21st.

Auroras were reported as follows: Halifax, 14th; Father Point, 30th; Quebec, 1st; Banff, 1st, 2d; Minnedosa, 2d, 3d, 5th, 28th, 30th; Qu'Appelle, 2d; Swift Current, 2d, 19th; Calgary, 1st, 3d, 26th, 27th; Prince Albert, 1st; Battleford, 2d, 3d, 4th; Kamloops, 2d.

## CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Snowfall and rainfall are expressed in inches.

*Alabama.*—The mean temperature was 42.2°, or 0.7° below normal; the highest was 83°, at Healing Springs on the 12th, and the lowest, 7° below zero, at Valleyhead on the 28th. The average precipitation was 3.60, or 1.76 below normal; the greatest monthly amount, 5.74, occurred at Greensboro, and the least, 1.23, at Pineapple.—*F. P. Chaffee.*

*Arizona.*—The mean temperature was 46.3°, or 6.3° above normal; the highest was 80°, at Maricopa, and the lowest, 5°, at Fort Apache on the 7th. The average precipitation was 3.16, or 2.16 above normal; the greatest monthly amount, 8.30, occurred at Pinal Ranch, and the least, 0.23, at San Simon.—*W. T. Blythe.*

*Arkansas.*—The mean temperature was 38.9°, or 0.7° below normal; the highest was 76°, at Texarkana on the 1st, and the lowest, 2° below zero, at Silver Springs on the 27th. The average precipitation was 6.53, or 2.47 above normal; the greatest monthly amount, 13.83, occurred at Pinebluff, and the least, 3.57, at Picayune.—*F. H. Clarke.*

*California.*—The mean temperature was 45.5°, or 0.1° below normal; the highest was 82°, at Coronado and Nordhoff on the 22d, and the lowest, 14° below zero, at Bodie on the 18th. The average precipitation was 2.69, or 1.83 below normal; the greatest monthly amount, 9.10, occurred at Mutah Flat, Ventura County, and the least 0.32, at Bishop, Inyo County. The unusual feature of the month was the greater rainfall in southern California as compared with the central and northern portions, the greatest rainfall occurring south of the Tehachapi range of mountains, while the least amount was in central and eastern California. This reverses the usual precipitation for the month of January. The excess of rainfall will be very beneficial to southern California, as the seasons have been drier than usual for several years past.—*J. A. Barwick.*

*Colorado.*—The mean temperature was 21.8°, or 3.0° above normal; the highest was 67°, at Cripple Creek on the 10th and 11th, and at Minneapolis on the 23d, and the lowest, 32° below zero, at Lay on the 27th. The average precipitation was 0.82, or 0.8 below normal; the greatest monthly amount, 8.60, occurred at Ruby, and the least, 0.06, at Lamar.—*F. H. Brandenburg.*

*Florida.*—The mean temperature was 56.2°, or 3.8° below normal; the highest was 86°, at Kissimmee on the 4th, and the lowest, 17°, at Pensacola on the 28th. The average precipitation was 1.90; the greatest monthly amount, 5.20, occurred at Jupiter, and the least, 0.18, at Kissimmee.—*A. J. Mitchell.*

*Georgia.*—The mean temperature was 42.6°, or 2.8° below normal; the highest was 77°, at Morgan on the 2d, Quitman on the 1st and 3d, and Brag on the 3d; the lowest was 6° below zero, at Tallapoosa on the 27th. The average precipitation was 2.66, or 2.44 below normal; the greatest monthly amount, 5.89, occurred at Diamond, and the least, 0.59, at Poulan.

*Idaho.*—The mean temperature was 23.1°; the highest was 58°, at Pollock on the 22d, and the lowest, 30° below zero, at Lake and Warren on the 26th. The average precipitation was 0.78; the greatest monthly amount, 2.82, occurred at Fort Sherman, while none fell at Martin.—*D. P. McCallum.*

*Illinois.*—The mean temperature was 24.1°, or 0.5° above normal; the highest was 70°, at Mt. Vernon on the 1st, and the lowest, 28° below zero, at Oregon on the 25th. The average precipitation was 4.59, or 2.30 above normal; the greatest monthly amount, 10.38, occurred at La Harpe, and the least, 1.96, at Scales Mound.—*C. E. Linney.*

*Indiana.*—The mean temperature was 25.3°, or 0.8°, below normal; the highest was 68°, at Vevay on the 1st and 3d, and lowest, 22° below zero, at Lafayette on the 25th. The average precipitation was 3.39, or 0.48 above normal; the greatest monthly amount, 5.97, occurred at Valparaiso, and the least, 1.73, at Greensburg. The weather during the month was not very favorable for wheat and clover, but there is no doubt that a good covering of snow during the greater part of the month protected these crops from greater injury during the exceedingly cold nights in the latter part of the month.—*C. F. R. Wappenhans.*

*Iowa.*—The mean temperature was 17.2°; the highest was 66°, at Keokuk and Madrid on the 1st, and the lowest, 30° below zero, at Rock Rapids on the 25th and at Elkador on the 26th. The average precipitation was 2.01; the greatest monthly amount, 6.16, occurred at Fort Madison, and the least, 0.15, at Portsmouth.—*G. M. Chappel.*

*Kansas.*—The mean temperature was 28.4°, or 0.4° above normal; the highest was 68°, at Columbus and Ottawa on the 1st, and the lowest, 16° below zero, at Goodland on the 27th. The average precipitation was 1.10, or 0.36 above normal; the greatest monthly amount, 5.46, occurred at Columbus, and the least, "trace," at Goodland and Grainfield.—*T. B. Jennings.*

*Kentucky.*—The mean temperature was 32.0°; the highest was 75°, at Ashland on the 3d, and the lowest, 16° below zero, at Louisa on the 30th. The average precipitation was 3.25, or 0.73 below normal; the greatest monthly amount, 4.96, occurred at Pilot Oak, and the least, 2.10, at Louisa. The general effects of the low temperature that prevailed the last week have not yet been ascertained definitely, but it is not likely they will be of a serious nature. The cold wave set in on the night of the 24th, and a general fall of snow occurred on the 27th, which was the central date of the cold period. This snow aided materially in heating the soil at about the time when it had become thoroughly frozen. It is probable that winter grain withstood the cold spell without much injury to the crop. Winter pastures had been excellent up to the period of cold weather.—*Frank Burke.*

*Louisiana.*—The mean temperature was 47.5°, or 3.1° below normal; the highest was 80°, at Melville on the 3d, and the lowest, zero, at Farmerville on the 26th. The average precipitation was 5.50, or 0.94 above normal; the greatest monthly amount, 12.20, occurred at Oberlin, and the least, 1.88, at Lawrence. It is evident that the severe cold of the latter part of January did considerably less damage than was expected, even to the orange trees and tender vegetation, and none